



Materials for Life Cycle Optimization
Presented at Space Day, UCF, 2012
Martha Williams, Ph.D., Lead Polymer Scientist
Kennedy Space Center, FL 32899
www.nasa.gov

Materials for Life Cycle Optimization

2.0 Materials for Life Cycle Optimization

2.1 Material Assessment

- Goals:**
- 1) Decrease processing cost
 - 2) Improve processing efficiency
 - 3) Increase safety
 - 4) Reduce risk

2.2 Self-Repair Systems

- Goals:**
- 1) Enable long duration missions
 - 2) Increase safety
 - 3) Reduce risk

2.3 Thermal Insulation

- Goals:**
- 1) Enable long duration missions
 - 2) Improve energy efficiency
 - 3) Increase safety
 - 4) Reduce risk

2.4 Electrostatic Dissipative Technologies

- Goals:**
- 1) Enable long duration missions
 - 2) Improve processing efficiency
 - 3) Increase safety

2.5 Long Life Materials for Extreme Environments

- Goals:**
- 1) Enable long duration missions
 - 2) Decrease processing costs

2.6 Manual Repair of Advanced Materials

- Goals:**
- 1) Enable long duration missions
 - 2) Decrease processing costs

Past and Current Partnerships

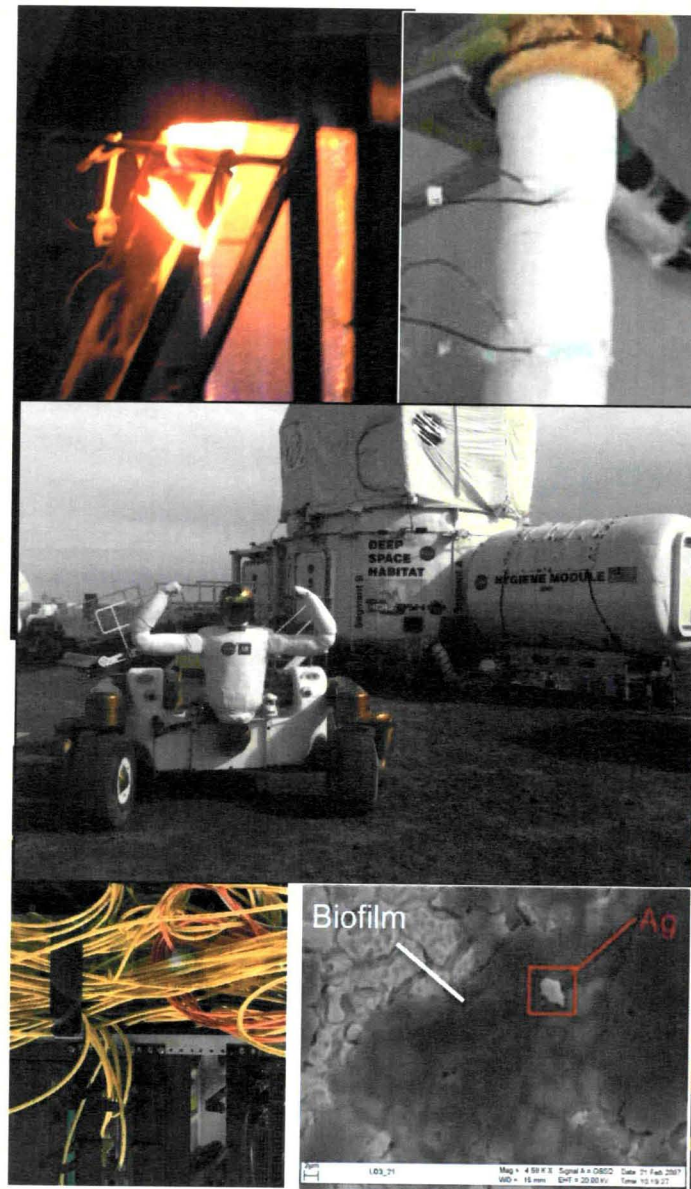
- **NASA Centers:** (JSC, LaRC, MSFC, GSFC, and GRC)
- **Academia:** (UCF, UF, USF, FIT, Embry Riddle, Georgia Tech, Alberta, Harding, Illinois-Urbana Champagne, University of Southern Mississippi, Manhattan College)
- **Industry:** (Thermax, DeWAL, Sharklet, Crosslink, Sabic, Amalgam, ARCnano, Epner, Conductive Composites, TE Connectivity, Automobile, Coatings and Pigments Industries)
- **Other Government Agencies:** DoD, including NAVAIR, Air Force and Army; DoE and EPA.

Polymer Science and Technology

- Flame retardant materials (with FIT)
- Self healing materials for wiring and inflatable structures
- Next generation wire materials, new wire constructions
- Detection systems for wiring and flat surfaces
- Aerogel composites for reducing heat transfer
- Foam thermal insulation materials
- Switchable materials for transient thermal management applications (with UCF)
- Conductive polymers and carbon nanotube (CNT) composites for printed circuitry and damage detection
- Aerogels for environmental remediation
- Chemochromic hazardous gas detectors (with UCF)
- Antimicrobial polymers for potable water system and closed loop systems
- Novel concepts for radiation shielding

Contact: Martha K. Williams, Ph.D.

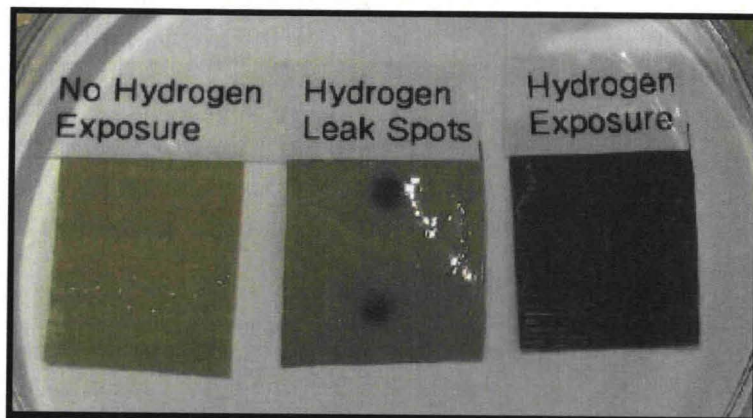
Martha.K.Williams@nasa.gov



H2 Sensing Technologies and UCF Partnership



KSC Irreversible Sensor



Works like a dosimeter:
Rate of color change depends on concentration and time.

LPA OMBUU Deployment for STS 117, 118, 120, 122, 123

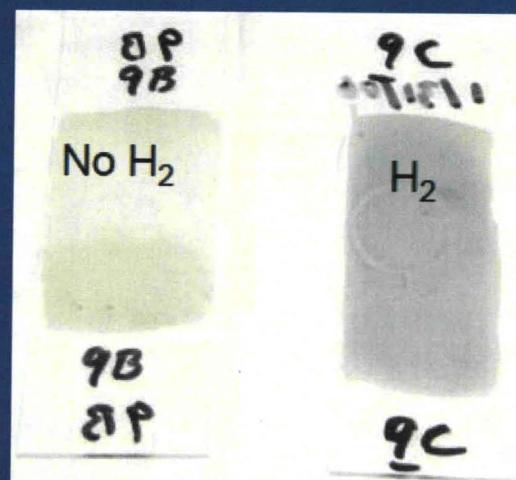


Response time is slower at cryogenic temperatures but sensor can
be engineered to avoid these conditions.
and STS 130, 131

Contact: Luke Roberson, Ph.D.
Luke.B.Roberson@nasa.gov

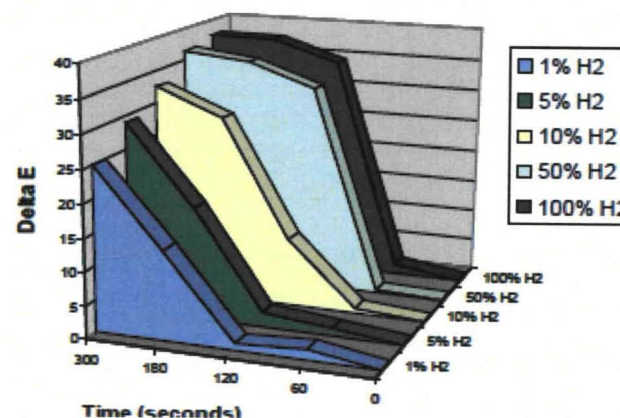
Reversible Sensor

UCF



Paint, Tape, and Paste

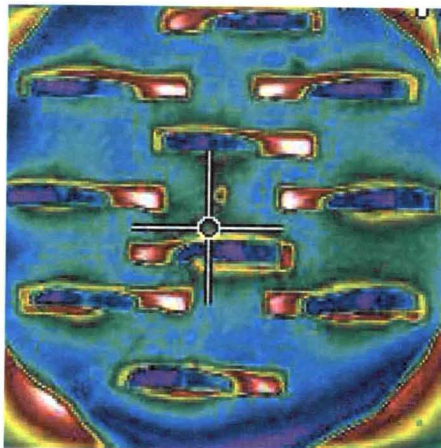
H2 Concentration Effect on Delta E



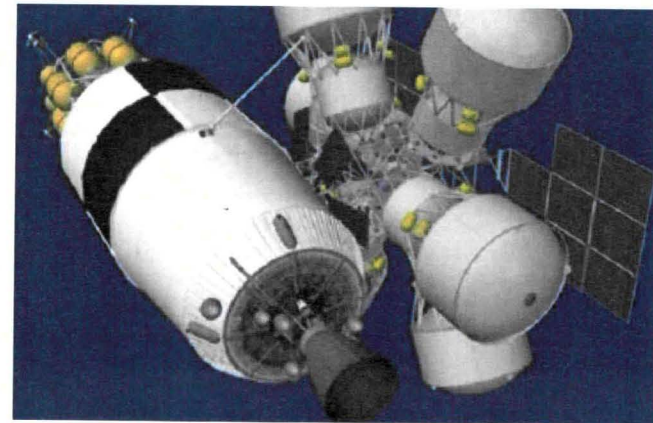
Shape Memory Alloys for Transient Thermal Applications

KSC and Florida Space Institute/University of Central Florida Partnership

- The goal of this project is to bring together novel, unique materials and transient thermal systems. The project will identify novel materials and utilize specialty or custom made shape memory alloys that can adapt under transient thermal management applications, including cryogenic applications. *All within a single architecture*



Infrared image at actuation

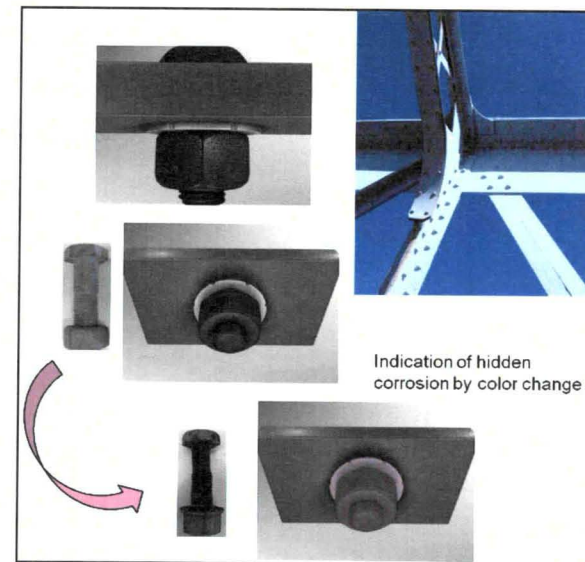
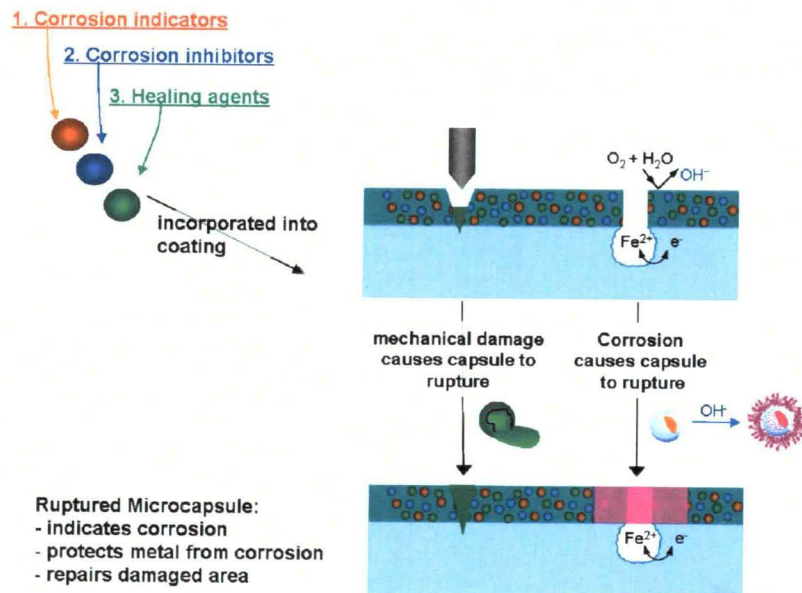


Future applications

NASA's Corrosion Technology Laboratory

Research and Development

- Coating development (Smart coatings for corrosion detection and control).
- Corrosion resistant materials and maintenance procedures for different environments.
- Investigation of materials degradation in different environments.
- Long-term prediction of corrosion performance from accelerated tests.
- Detection of hidden corrosion.
- Self-healing coatings.



Hidden Corrosion Indication Concept

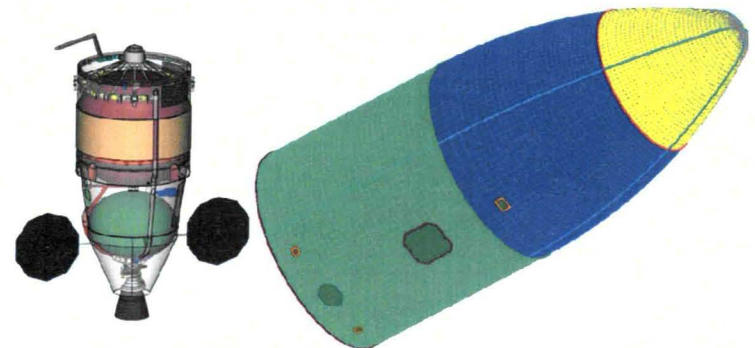
Contact: Luz Marina Calle, Ph.D.

Luz.M.Calle@nasa.gov

Fiber Composites Research and Development

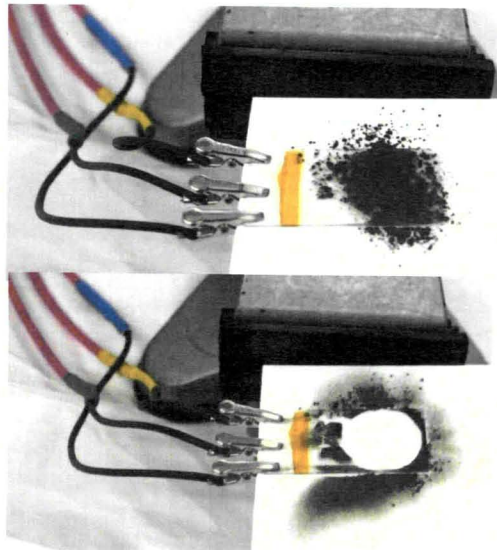
- NASA Exploration Systems Directorate Composites for Exploration (CoEx)
 - Inter-center team responsible for investigating the potential to develop composite materials and structures technologies
 - Largest composite aerospace structures ever made - heavy lift launch vehicle payload fairing applications.
- NASA Office of Chief Technologist/Game Changing Division Composite Cryotank Technologies and Demonstration Project (CCTD)
 - Inter-center team responsible for developing and demonstrating advanced composite technologies
 - Goal is to achieve 30% weight savings 25% cost savings of LH₂ composite cryotanks.
- Non-destructive evaluation, inspection tools and structural health monitoring
 - Developing new tools that will allow for inspection and continual monitoring of fiber reinforced composite systems
- Self-repair for fiber composite systems

Contact: LaNetra Tate, Ph.D.
LaNetra.C.Tate@nasa.gov
321-867-3789



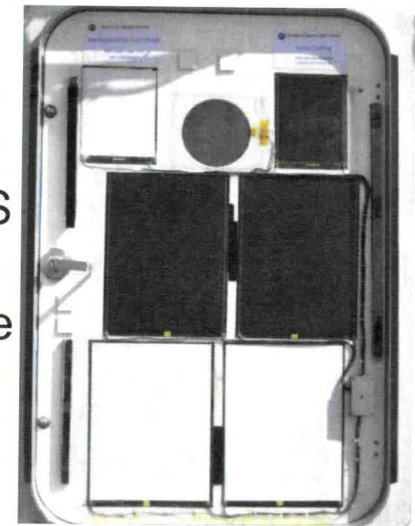
Electrostatics & Surface Physics Laboratory

- Dust mitigation and electrostatic dissipative technologies for Lunar and Mars Exploration
- Habitat Demonstration Unit dust mitigation panels
- Dust mitigation technologies for Materials International Space Station Experiment (MISSE)
- Electrostatic dissipative technologies for optical systems
- NIAC Research regolith-derived heat shields for atmospheric entry
- Electrostatic dust precipitation for *In-situ* Resource Utilization (ISRU)



Dr. Carlos I. Calle
Carlos.I.Calle@nasa.gov

Right – EDS
on HDU
hatch before
operation
Left – EDS
after
operation



Dr. Michael Hogue
Michael.D.Hogue@nasa.gov

Specialty Capabilities at KSC

Capabilities:

- **KSC Beachside Atmospheric Exposure**

Contact Information

<http://corrosion.ksc.nasa.gov/>

Dr. Luz Marina Calle.

Luz.M.Calle@nasa.gov

- **Unique Electrostatics and Surface Physics Laboratory**

Dr. Carlos I. Calle

Carlos.I.Calle@nasa.gov

- **One-of-a-kind Cone Calorimeter for fire testing**

Dr. Martha. K. Williams

Martha.K.Williams@nasa.gov

- **Composite repair new procedures and techniques for out of autoclave**

Dr. Lanetra C. Tate

Lanetra.C.Tate@nasa.gov

